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Achieving Accelerated and Shared Growth in Ghana:

A MAMS-Based Analysis of Costs and Opportunities

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Abstract

This paper relies on the recently developed Maquette for Millennium Development Goals Simulations (MAMS) model to assess the consistency of alternative scaling-up and policy packages for growth and achievement of the Millennium Development Goals in Ghana. In the baseline scenario, Ghana's strong near and medium-term growth outlook puts it in a good position to achieve the poverty Millennium Development Goal ahead of schedule, but other goals are likely to remain elusive before 2015. In the accelerated growth scenario—which addresses the major gaps in water and sanitation and other infrastructure—even more rapid growth and poverty reduction are possible, but important targets in the areas of education, health, and environment remain unattainable. Although growth is complementary to achievement of the Millennium Development Goals, the authors also find important growth-human development trade-offs in the near term. The estimates show that the resource requirements for achieving the key Millennium Development Goals by 2015 are large, reaching US$82 per capita in an illustrative foreign-grant financed scenario. Increased intake and retention of students contribute to rising scarcity of unskilled labor, buttressing unskilled wages, while high demand for skills from the sectors related to the Millennium Development Goals raises the returns to human capital. These developments lead to improvements in the welfare of the poorest members of Ghanaian society and contribute to a small reduction in overall inequality.

This paper—a product of the Africa Poverty Reduction and Economic Management and the Development Economics Prospects Group—is part of a larger effort in the department to collect data and develop analytical tools for monitoring progress towards the achievement of the Millennium Development Goals.Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The authors may be contacted at zbogetic@worldbank.org, mbussolo@worldbank.org, and dmedvedev@worldbank.org.

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Achieving Accelerated and Shared Growth in Ghana: A MAMS-Based Analysis of Costs and Opportunities[♦]

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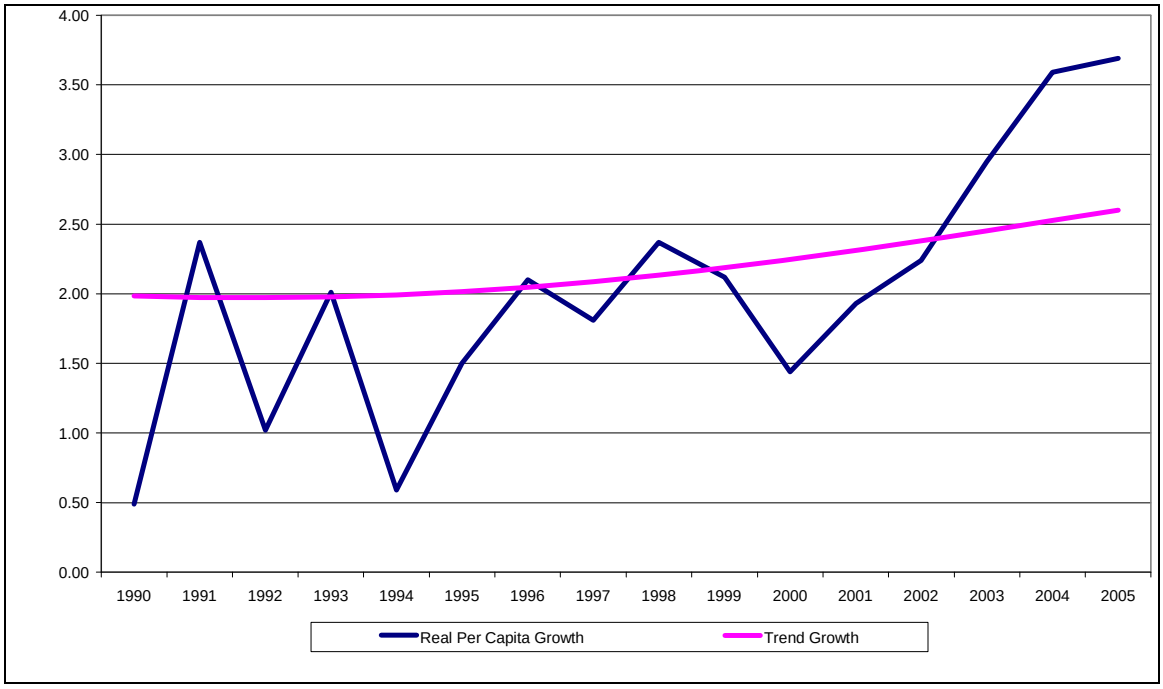
1. Introduction

In recent years, the improved policy environment, increased donor assistance, and macroeconomic stability have combined to raise Ghana's growth performance significantly above historical averages. After two and a half decades of independence[1], Ghana's per capita income has hardly changed, in large part due to political instability and frequent shifts in the policy paradigms that hurt entrepreneurship, investments and growth. Real per capita income has only started growing slowly after the return of political stability in 1983, which also coincides with the beginning of structural reforms. Since 1990, however, Ghana's per capita growth accelerated visibly to about 2 percent and then even more during the first years of the new century (Figure 1).

Figure 1 Ghana's Long-Term and Short-Term Growth Trends, 1990-2005 (percent)



Source: The authors' calculation using World Development Indicators data. Trend growth was calculated as the HP-filter for the period 1990-2005.

These recent developments bode well for the government's objective of doubling the country's per capita income in the next decade. At the same time, numerous risks remain. Despite the strong growth performance, resource and export base of the economy is narrow and Ghana is highly vulnerable to external shocks. In addition to a looming energy crisis, the country faces major infrastructure gaps in water, sanitation, and roads. Finally, the focus on growth—which is vital for meeting social objectives and the Millennium Development Goals (MDGs)—must not detract from the remaining, critical social agenda in improving health and education outcomes in a low-income country.

[1] Ghana was the first Sub-Saharan African country to earn independence from Great Britain on March 6, 1957.

In the context of these challenges and with a view towards Ghana's objective of achieving high growth and reaching the four key MDGs—poverty, education, health and water and sanitation[2]—this paper presents an analysis of the consistency of alternative scaling up and policy packages, which had been considered by the government of Ghana in its development partners.[3] Using the Ghana-specific Maquette for MDG Simulations (MAMS) model—a dynamic general equilibrium model extended to include explicit 'production functions' for MDGs—we develop three main policy scenarios.

In the baseline scenario, Ghana' strong medium-term growth outlook puts it in a favorable position to achieve the poverty MDG ahead of schedule, even though the achievement of the four MDGs are likely to remain elusive.

In the second scenario, the removal of bottlenecks in key infrastructure and water/sanitation sectors put Ghana on a path to accelerated growth and improved MDG achievement. Arguably, accelerated growth and closing of the infrastructure gaps allows greater sharing of the benefits of growth among the vulnerable groups and, therefore, further progress in the achievement of MDGs. An important and simple point is that growth is good for MDGs. However, there is no free lunch: this acceleration in growth is not costless, and the increase in taxes (or grants/borrowing) required to finance accelerated investment in infrastructure and water may slow growth in private consumption and, therefore, limit the pace of additional poverty reduction.

In the third scenario, we show that even with the best policy intentions and feasible gains in productivity, MDGs are only likely to be achieved with a large additional scale-up in resources (e.g., aid), considerable improvements in the efficiency of service delivery, or, most likely, some combination of these policies. The basic reason for the large resource requirements under this scenario lies in the significant distance between the starting and target points on Ghana's four MDGs. And this may be a more general point for other African low-income countries: full achievement of key MDGs, indeed, might require significant resources (i.e., aid in the case of Africa) even with the best of policies and gains in efficiency that must accompany such "development bargain."

For all three scenarios, our analysis takes into consideration the general equilibrium consequences for the rest of the economy, which include some crowding out of the private sector, real exchange rate appreciation, and increased pressures in the labor markets. The rest of the paper is organized as follows. Section 2 discusses the model and data used in the exercise, while section 3 contains the detailed analysis of the above three scenarios. Section 4 provides concluding remarks.

2. Model and data

This paper relies on the MAMS model for the analytical framework to assess the growth and human development (HD) consequences of an accelerated growth and MDG achievement strategy. MAMS is a dynamic general equilibrium model that explicitly links progress on the human development (HD) front to the rest of the economy through

[2] The choice of the MDGs used in the analysis was dictated by the policy focus of the government and development partners and the availability of data.

[3] These scenarios were presented and discussed at the Ghana Consultative Group (CG) Meeting in June 2007 in Accra.

public expenditure, labor markets, and private demand for public services.[4] The non-MDGs features of the model are standard in the CGE literature, as MAMS traces its ancestry to the IFPRI standard model.[5] MDGs are modeled with a "production function" approach. Progress is conditional on improved level of public service delivery (through increased expenditure and/or enhanced efficiency), demand for services, improvements on other MDGs, and investments in infrastructure.

A key objective of MAMS is to capture the main interactions between the pursuit of the MDGs and the evolution of the economy. For this reason, it focuses on the sub-set of goals where the numerical targets are well-defined and data is likely to be available for analysis. These are: universal primary school completion (MDG 2), reduced under-five and maternal mortality rates (MDGs 4 and 5), and increased access to improved water sources and sanitation (part of MDG 7). Achievements in terms of poverty reduction (MDG 1) are also monitored, although the model does not contain any policy levers for specific MDG 1-related interventions. The determinants of achieving these targets are summarized in Table 1.

Table 1 Determinants of MDG achievement in Ghana MAMS

	MDG	1 Poverty Reduction	2 Primary Education	4 Infant Mortality	5 Maternal Mortality	7a Access to Water	7b Access to Sanitation
Per capita public service delivery			X	X	X	X	X
Other Determinants	Per capita consumption	X	X	X	X	X	X
	Employment changes	X					
	Wage growth	X	X				
	Public infrastructure		X	X	X	X	X
	Other MDGs		4, 7a, 7b	7a,7b	7a,7b		

Production of the above-mentioned MDGs (with the exception of MDG 1) is modeled as a nested system of two functions. At the bottom level of the MDG production nest, the model computes an aggregate measure of MDG service delivery by taking into account public and private expenditure on MDG services, availability of infrastructure services, positive spillovers from progress on other MDGs, and demand-side effects (see Table 1). Expansion in per capita service delivery requires increased commitments of three broad categories of inputs: labor (which is disaggregated according to skill/education levels), capital, and intermediate goods. In addition to these inputs, which account for spending on specific MDG interventions, the aggregate measure of MDG service delivery is also determined by complementary policies. For example, reaching the health MDG requires improvements in health service delivery per capita, but is also facilitated by improvements in sanitation conditions (proxied by MDGs 7a and 7b), by better infrastructure (e.g., better roads to schools), and by higher income levels (better-off

[4] The following discussion highlights the features of the MAMS model most relevant for our analysis. An interested reader should refer to Lofgren and Diaz-Bonilla (2006) for a full model description.
[5] See Lofgren, Harris, and Robinson (2002) for the IFPRI standard model.

parents may not need their children to work). The aggregate measure is strictly increasing in all of its components, and does not capture potential bottlenecks and/or the decreasing returns to scale as the target approaches (due to the difficulty of reaching the most remote parts of the population or, for example, necessity of high-level medical care to reduce maternal mortality beyond a certain threshold). In order to account for these effects, the top level of the MDG production nest links this aggregate measure of MDG service delivery to actual MDG outcomes by requiring greater and greater improvements in the former for the same rate of improvement in the latter. This is accomplished by using a logistic function with the MDG outcome as a dependent variable and the aggregate measure of MDG service delivery as an independent variable.

The treatment of the education sector slightly differs from other MDGs. The model explicitly tracks base-year stocks of students and new entrants through three education cycles: primary, secondary, and tertiary. In each year, students can successfully complete their grade, repeat it, or drop out of their cycle. Similar to other MDGs, student performance depends on educational quality (growth in spending per student), improvements in household welfare (per-capita household consumption, which captures the demand side), growth in public infrastructure spending, and other MDGs. However, educational outcomes are also positively influenced by good returns to education (proxied by the wage premium paid to skilled workers).[6] The achievement of MDG 2 requires that all students in the relevant age cohort enter the primary cycle and successfully complete each year within this cycle. In the model, this is translated into requiring that the rates of 1st grade entry, graduation, and continuation to next grade within the primary cycle are at or very close to 100 percent for a six-year period prior to 2015.

A major advantage of MAMS is its ability to simultaneously determine MDG progress, supply and demand of private goods and services, and factor markets equilibrium. In the model, this is accomplished through several links between the MDG module and the rest of the economy. Firstly, the increase in government service provision needed to reach the MDGs requires additional resources—capital and investment, labor, and intermediate inputs—that become unavailable to the rest of the economy. As an example, this link allows the model to capture the wage hikes for skilled labor that may stem from the combination of its small supply and rapid demand expansion (from MDG services that are intensive in skilled labor). These demand increases are likely to reduce the number of skilled workers available to the private sector even as increased school enrollment reduces the overall labor force. On the other hand, by allocating graduates and dropouts from the education system to different segments of the labor force (as a function of the highest degree achieved), MAMS captures the supply side of expanding education services, which works in the opposite direction by depressing relative wages of labor categories with the most rapid growth. If government services rely heavily on these labor types, government costs and financing needs decline. Moreover, a higher average level of education raises the productivity and the wages of the labor force, with a positive feedback on growth, private incomes, government revenues, and MDG achievements.

[6] A large micro-econometric literature exists on how to model the production and the demand for education. MAMS simply summarizes the most salient points of this literature in a simple reduced form equation. The main advantage of this approach is its general equilibrium method but it is not at all a substitute to more detailed sectoral analyses.

The base year for the Ghana MAMS model is 2004. The data for the exercise come from a social accounting matrix (SAM) as well as detailed sector studies that describe the current situation in each of the human development (HD) sectors (education, health, water/sanitation) and quantify the progress required to reach the MDGs. The SAM was built by constructing a macroeconomic SAM from the national accounts data and then disaggregating it further by relying on public budget documents, income and consumption data from the fifth round of the Ghana Living Standards Survey (GLSS5), and a detailed Ghana SAM constructed by Ghana Statistical Services and the International Food Policy Research Institute (Ghana Statistical Services, 2006). Given that our primary focus is on government policies related to MDG achievement, we maintain a simple structure for the rest of the economy by aggregating all private activities into three sectors: agriculture, manufacturing, and services (see Table 2).

Table 2 Model dimensions

Activities/commodities
Private (3)
Agriculture
Manufacturing
Services
Public (7)
Primary education
Secondary education
Tertiary education
Health
Water and sanitation
Infrastructure
Other government
Factors (11)
Unskilled labor--workers who have not completed secondary school
Skilled labor--workers who have completed secondary school
Tertiary-skilled labor--workers who have completed tertiary education
Capital (8)--one stock for each model activity
Institutions (3)
Household
Government
Rest of the world

A major difference of the Ghana MAMS SAM from the one constructed by GSS and IFPRI is the disaggregation of public current expenditures and investments into the different activities covering education, health, water and sanitation, other infrastructure, and other public activities. This disaggregation is mostly based on public expenditure figures published in the Ghana External Review of Public Financial Management (World Bank, 2006) and the Report of the Auditor General on the Public Accounts of Ghana (Government of Ghana, 2004). Such breakdown of public expenditures in the model also allows a more systematic analysis of trade offs between various types of public expenditures.

The production functions for the MDGs have been calibrated to assure that, under base-year conditions, base-year performance is replicated and that, under a set of other conditions identified by HD sector studies, the relevant targets are fully achieved. This approach also implies that the modeling of MDG production functions does *not* mechanically link more inputs, i.e. increased production of social services, to higher attainments, but reproduces, in reduced form, the functioning of the social sectors and the interactions of demand and supply within them. Thus, the model consolidates knowledge from sector studies and incorporates various bottlenecks that are likely to hinder MDG achievement. The following studies were consulted for estimates of costs required to reach the MDGs. For education, the Ghana MAMS model relies on the Education Strategic Plan published by the Ministry of Education in the Government of Ghana (Government of Ghana, 2003). For health, the main source of information is the Marginal Budgeting for Bottlenecks (MBB) model developed by the human development experts at the World Bank. For water and sanitation, the main input is "Getting Africa on Track to Meet the MDGs on Water and Sanitation: A Status Review of Sixteen African Countries" (Africa Ministers' Council on Water, 2006).

The cross-MDG synergies in the current application have been specified in accordance with the available sector evidence. Thus, the positive impact of improvements in access to water and sanitation on the health outcomes is consistent with the Ghana MBB model, while the importance of infant health as well as water and sanitation targets for achieving universal primary completion is clearly delineated in the Education Strategic Plan. The model considers only the *public* provision of MDG services, given the lack of detailed data on private service delivery and the fact that the incidence of private service falls mainly on the wealthy parts of the population.

MAMS is compatible with several alternative methods of tracking the progress on poverty reduction. A simple option is to use an estimated elasticity of poverty reduction with respect to growth in households' per capita consumption. But of course, this simple approach fails to take into account the underlying characteristics of the distribution of income and consumption. This paper takes a more sophisticated approach by utilizing a macro-micro framework, where a set of aggregate results from MAMS are passed on to household survey data by means of a micro-simulation module. The data for our micro-simulations come from the most recent household survey for Ghana (GLSS5), where employment and labor earnings by skill and sector are easily identified. The simulations then apply changes in employment, skill levels, relative wages, and consumption per capita from MAMS to each household in the survey, producing a new distribution of income and translating the evolution of macro variables into poverty outcomes.[7] Unlike the simpler poverty elasticity-based methods, the micro-simulation approach allows for four main avenues of escaping poverty: (i) moving from agricultural employment to non-farm activities where the wages tend to be higher, (ii) upgrading individual skills (through schooling), (iii) changes in relative wages across sectors, and (iv) an economy-wide growth component that equally benefits all households (Table 1).

[7] The micro-simulations are carried out at the household level due to the difficulties of accounting for within-household distribution of income. Therefore, we introduce a certain imprecision in our results as the entire household shares in the labor market outcomes of the household head (e.g., if the head of the household is an unskilled worker in agriculture, then the per capita welfare metric for the entire household will change following the changes in unskilled agricultural wages in MAMS).

Since no elasticity values (MDG or otherwise) are available for Ghana and their estimation is problematic due to data constraints, the values of key model elasticities have been borrowed from other relevant studies (e.g., the default elasticities of the IFPRI standard model as well as the MDG elasticities from Diaz-Bonilla and Lofgren (2005) for Ethiopia). Although this introduces a certain degree of imprecision in the model results, we believe this approach is justified for two main reasons. First, our elasticity values are within a reasonable range as established in the existing CGE literature. Second, the conclusions of this study are not meant to be taken as definitive statements about the resource scale-up requirements to reach the MDGs in Ghana; indeed, the resulting estimates should be viewed as illustrative, providing a range of likely resource requirements. But the main purpose here is to highlight the relative importance of various determinants of MDG outcomes and, within a consistent economy-wide framework, discuss the relative merits of various sources of financing and the implications of a targeted pursuit of MDGs on the rest of the economy. Thus, while the exact quantitative findings of this study may be subject to revision if better elasticity estimates become available, the qualitative conclusions should remain applicable.[8]

3. Growth and MDG performance

The recent robust growth performance of the Ghanaian economy has led to an accelerated pace of poverty reduction. The annual pace of real GDP growth has increased steadily from 3.7 percent in 2000 to 6.2 percent in 2006, despite high oil prices. This strong performance reflects the improved macroeconomic and financial stability, which removed two of the key constraints to private sector growth (Ghana Joint Assistance Strategy, 2007). Moreover, recent growth has been strongly poverty reducing, with the proportion of the population in poverty declining significantly from about 52 percent in 1990 to less than 31 percent in 2004 (Table 3) and then, according to the latest GLSS-5 data, to just 28.5% in 2005/6. This record of growth and poverty reduction underscores the primacy of growth in reducing poverty in Ghana and, therefore, the criticality of pro-growth policy environment.

However, despite the impressive progress on the poverty MDG noted above, sharing of growth benefits and improvements in other Millennium Development Goals (MDGs) have been more limited. Although important strides have been made in many areas of human development, until now the progress on education, health, and water/sanitation MDGs has been moderate (Table 3). Precise assessment of progress here is difficult due to data limitations and scarcity as well as multi-dimensional nature of

[8] For example, the Armington and CET elasticities of the model—1.2 and 1.5, respectively, for agriculture, 0.9 and 1.2 for manufacturing, and 0.7 and 1.1 for services—are well within the range presented in a review of literature by Annabi et al (2006). Doubling these elasticities lowers the resource requirements for MDG achievement in US$ by less than 5 percent, while the difference in resource requirements as a percent of GDP is negligible. Doubling the elasticity of GDP growth with respect to changes in the infrastructure capital stock (default 0.292 for water and sanitation and 0.288 for other infrastructure) lowers the ratio of resource requirements to GDP in 2015 from 10.9 percent to 10.5 percent, while having almost no impact on the required amount in US$. The impact of changing MDG-related elasticities—the values of which are much more uncertain than trade and production elasticities—is more pronounced, but still within reasonable bounds. Thus, doubling the elasticity of MDG outcomes with respect to the provision of public infrastructure (default 0.10) *and* doubling the elasticity of MDG outcomes with respect to growth in private consumption (default 0.10) lowers the US$ costs of MDG achievement by around 17 percent.

some of the MDGs, but the broad results suggest that improvements across the MDGs have been uneven. Significant progress is taking place in basic education, aided by the abolition of basic school fees in 2005 and enhanced expenditure allocation towards the lagging regions (Ghana Joint Assistance Strategy, 2007), although concerns about *quality* of education (e.g., test performance) remain. Efforts to reduce child and maternal mortality have practically stalled since Ghana Poverty Reduction Strategy (GPRS) I, which is worrisome since health sector expenditures have risen over the same period (Ghana Joint Assistance Strategy, 2007). Finally, although access to water and sanitation services has been improving, *inequalities* in access (particularly between rural and urban areas) and issues of *quality* in this sector remain a major bottleneck for development.

Table 3 MDG progress in Ghana, 1990-2004

		1990	2004	Target
Poverty headcount	(%)	52	31	26
Primary completion rate	(%)		47	100
Under-5 mortality	(per 1,000)	122	112	40
Maternal mortality	(per 100,000)	740	503	185
Access to safe water	(%)	54	56	85
Access to sanitation	(%)	21	35	85

In the ***baseline scenario***, we project the current optimism about Ghana's strong medium-term outlook forward by lining up the dynamic (2004-2015) path of real GDP and external debt stocks with the assumptions and estimates of the latest Debt Sustainability Analysis (DSA) jointly conducted by the IMF and the World Bank in February 2007 (World Bank, 2007). Real GDP grows at an average annual rate of 6.9 percent through 2015, while population grows at 2.6 percent per year (Table 4), leading to an impressive 4.2 percent annual improvement in per capita income, while consumption per capita grows even faster.[9]

This is a private investment-led scenario: it includes continued, solid growth in private investments. Total investment-to-GDP ratio is maintained at the level of close to 29 percent, with the private sector contributing nearly 18 percentage points to this ratio by 2015. The economy also shows a dynamic overall export growth of about 6.6 percent per year. The real exchange rate appreciates by about 3 percent between 2004 and 2015 and the growth of exports lags behind import growth by 0.9 percentage points per year. The trade-to-GDP ratio rises by another 3 percentage points from an already high 2004 value of 101 percent. Due to debt relief under the HIPC initiative, the external debt-to-GDP ratio is almost halved over the 11 year period, which provides significant reprieve from debt service obligations and frees up public resources for other spending areas, such as human resource development. The volume of public spending (investment and

[9] It is important to notice that, as for most dynamic general equilibrium models as MAMS, real GDP growth is exogenous during the calibration of the model. This means that, given the growth rate for the labor force and the accumulation of capital, the growth of the productivity parameter is calculated so that the targeted real GDP growth is achieved. As shown below in Figure 2, significant efficiency gains are needed to reach the strong GDP growth assumed by the DSA. These efficiency gains can be, at least in part, attributed to the favorable policy environment and investment climate, however no attempt to econometrically estimate the link between these variables and efficiency gains was carried out for this study.

recurrent expenditures on social sectors as well as other budget categories) grows at the rate of planned expenditures by the Government of Ghana or, in the absence of this information at the disaggregated level, is assumed conservatively to grow at the same rate as real GDP.[10] As a result, government consumption grows at an average yearly rate of 5.7 percent (Table 4) and the share of public expenditure in GDP declines over the model horizon. Significantly, this scenario assumes the continued fiscal prudence of the government that has been demonstrated in recent years as well as its ability to contain public expenditure pressures in the medium term.

Table 4 Ghana: Projected macro variables in the three model scenarios

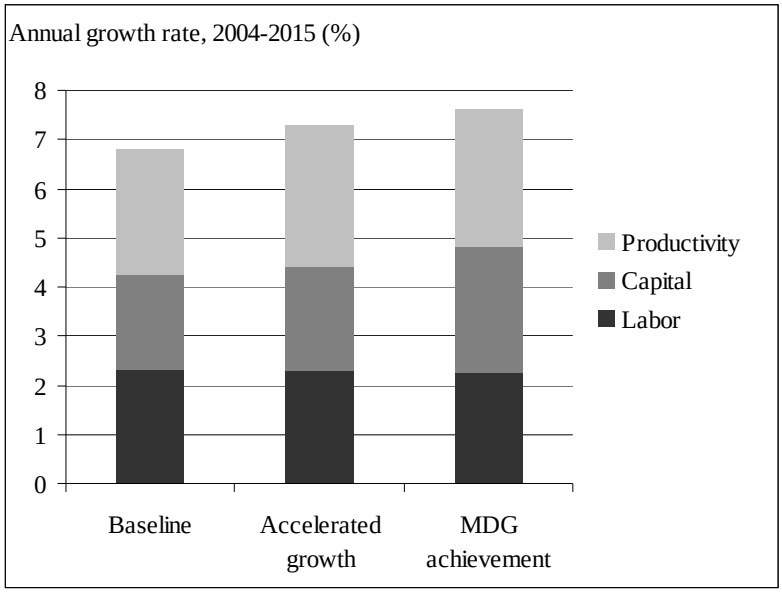
	2004	Baseline	Accelerated growth	MDG achievement
	Bln. Cedis	*Average 2004-2015 growth rate (%)*		
Real GDP at market prices	79,888	6.9	7.4	7.8
Private consumption	63,396	7.6	7.7	8.2
Government consumption	9,724	5.7	5.8	7.6
Private investment	12,782	7.8	8.2	9.9
Public investment	9,888	5.7	8.5	13.3
Exports	32,329	6.6	7.4	6.5
Imports	48,231	7.5	8.0	9.4
Real GDP per capita (thou Cedis)	3,688	4.2	4.7	5.1
Real Exchange rate (Cedis per USD)	1.00	-0.3	-0.1	-0.8
			2015 level	
Trade-to-GDP (%)	100.8	103.7	104.9	106.3
Investment-to-GDP (%)	28.4	28.5	31.2	41.3
Private	16.0	17.6	17.4	19.8
Public	12.4	11.0	13.8	21.4
External debt-to-GDP (%)	55.5	26.8	25.9	22.9
External debt service-to-exports (%)	2.9	1.4	1.3	1.3

Figure 2 shows the contributions of labor, capital, and productivity in sustaining the growth of real GDP at factor cost. It is clear in order to attain the baseline growth path described in the previous paragraph, Ghana's productivity growth must further accelerate from the recent (and already high by historical standards) growth of 1.6 percent per year to 2.6 percent per year. At this rate, the contribution of productivity to total GDP growth will be just under 38 percent. There is only one Sub-Saharan African country—Botswana—that has been able to sustain higher TFP growth rates over the 1981-2002 period (3.7 percent), although TFP in Uganda has been growing at an average annual rate of 2 percent during the same period (Akinlo, 2005).[11] It should be noted, however, that much faster productivity growth rates have been observed in other regions, most recently in the European and Asian transition economies (Alam et al., 2008). In terms of sectoral growth, manufacturing and services are the most dynamic sectors, growing at 7.9 and 7.6 percent per year, respectively. Agriculture grows at 6.0 percent per year, while the public

[10] For more details see Table 9 and Table 10 in the Annex.
[11] Note that the sample in Akinlo (2005) does not include South Africa.

sector growth is 5.4 percent per year.[12] The contributions to growth are as follows: agriculture 35 percent, manufacturing 18 percent, services 39 percent, and public services 8 percent. While the economy shows the expected movement towards higher value-added manufacturing and services sectors, the fact remains that agriculture will remain to play an important role in medium-term growth, given its significance in the initial period.

Figure 2 Sources of growth in the three model scenarios



If realized, the strong growth performance of the baseline scenario puts Ghana in a good position to reach the key poverty MDG well ahead of schedule. In fact, the latest GLSS-5 survey with poverty data for 2005/6 shows that to a large extent, this is already happening. As shown in Table 5, the poverty headcount for the year 2015 in the baseline scenario is estimated to be at 11 percent, thus exceeding with a large margin the target of 26 percent. This remarkable pace of poverty reduction is underpinned by strong growth in per capita household consumption and a moderate decrease in inequality, with the Gini index *declining* from 0.39 in 2004 to 0.38 in 2015 and the Theil index falling from 0.26 to 0.25 over the same period. The growth incidence curve of Figure 3 shows the consumption gains across the percentiles of the distribution, clearly illustrating the pro-poor bias of the growth process. The largest gains—approximately 25 percent more than the average—are observed among the poorest households in Ghana, and every member of the poorest one-half of the population enjoys above-average consumption gains. This pro-poor distributional shift is largely explained by robust growth in unskilled wages, which is underpinned by a well-performing educational system that dampens the growth in unskilled labor supply by keeping children in school longer (see the discussion below for more about labor market results).

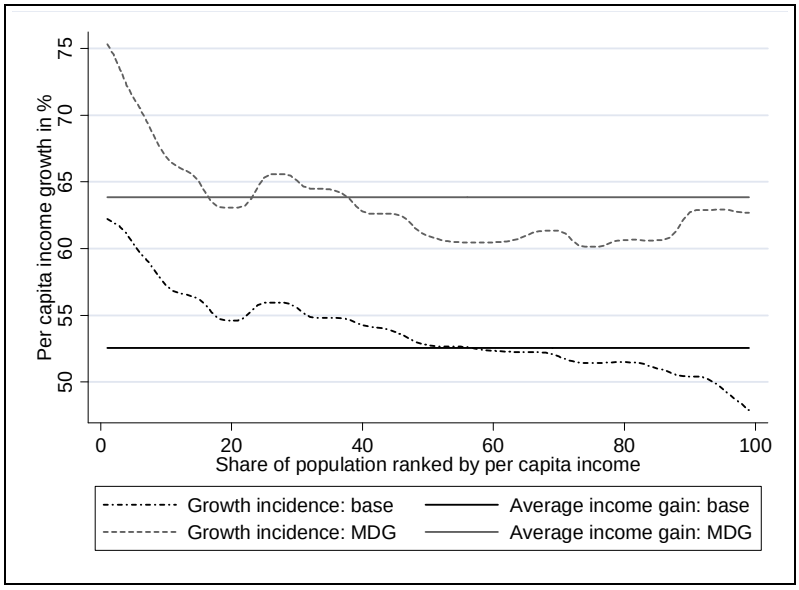
[12] Given that factors are mobile across sectors and there is no sector-biased productivity gain, the growth differential across sectors is explained by the fact that consumption elasticity with respect to income is higher for manufacturing and services. Therefore, with the large income growth recorded in these scenarios demand tends to shift away from agricultural goods and towards manufacturing and services.

Table 5 Ghana: Projected MDG achievements in the baseline scenario

		1990	2004	2015	Target	Distance to target
Poverty headcount	(%)	52	31	11	26	382%
Primary completion rate	(%)		47	88	100	76%
Under-5 mortality	(per 1,000)	122	112	97	40	20%
Maternal mortality	(per 100,000)	740	503	440	185	20%
Access to safe water	(%)	54	56	62	85	21%
Access to sanitation	(%)	21	35	47	85	23%

It should be noted that the projected narrowing of the income distribution in the baseline scenario is at odds with Ghana's inequality trends of the last 15 years (see Coulombe and Wodon, 2007). However, according to that study, growing spatial inequality has been one of the main drivers of increases in total inequality (the national Gini coefficient rising from 0.35 in 1992 to 0.39 in 2004). In particular, the poor in the northern regions—a historically poor area in Ghana—have largely been left out of the growth process that has been benefited other parts of the populating during the last decade and a half. Since the current version of the Ghana MAMS model does not include a regional dimension, this historically important element of the evolution in inequality has been left out of the analysis. Instead, the simplifying assumption is that all poor, regardless of geography, can benefit from the robust growth in unskilled wages in the baseline scenario.

Figure 3 Ghana: growth incidence curve for the baseline and MDG scenarios



To assess whether the decrease in inequality is particularly helpful in enhancing the poverty reducing effect of growth, the micro-simulation model is used to generate an additional counterfactual scenario where every individual gets the same average increase in his/her income (i.e., a hypothetical situation where growth is distributionally neutral). In this case, poverty would be reduced less, with the 2015 poverty headcount reaching 12.1 percent instead of 11.4 percent in the baseline scenario. The relatively small

difference between the two scenarios is explained by the shape of the growth incidence curve, where the largest gains accrue to households significantly below the poverty line (recall that the estimated poverty headcount in 2004 is 28 percent). Thus, although the baseline scenario has a very clear pro-poor distributional bias, households in the neighborhood of the poverty line gain only slightly more than the average consumer in Ghana.

Considering the other MDGs, our estimates show that, under the baseline scenario, solid progress is likely to take place in education, but little progress would take place in health, especially in the key indicators of child and maternal mortality. The rightmost column of Table 5 summarizes the progress across different targets by computing a measure of "distance to target," which is a ratio of improvement in each human development (HD) area in the baseline scenario to the total improvement required for MDG achievement. In education, 88 percent of children are expected to complete the primary cycle in 6 years. Although this falls short of the MDG of universal primary completion, good progress is made: 76 percent of the distance to target is covered in the baseline scenario. In contrast, relatively little progress is likely to take place in water and sanitation, where only 21 and 23 percent of total distance to target will be covered in the baseline. Finally, reductions in child and maternal mortality are even slower, with one-fifth of the required improvement likely to take place by 2015. Synergies across different MDGs play an important role: progress on education would likely be higher with more improvements in water and sanitation, which are identified in the Education Strategic Plan as a necessary condition for reaching the education MDG. Similarly, education is affected by the bottlenecks in health and infrastructure, and improvements in health outcomes are muted by the lack of progress in water and sanitation as well as other infrastructure.

The removal of bottlenecks in infrastructure (including energy) and water/sanitation can put Ghana on a path to ***accelerated growth***. In this scenario, the water and sanitation infrastructure spending is roughly doubled with respect to the baseline, whereas spending in the remaining sectors, namely energy, communication, roads and other transport services, goes up by a factor of about one-and-a-half.[13] This level of spending, in addition to further improvements in policies and efficiency, would address the identified infrastructure gaps in Ghana (see Estache and Vagliasindi, 2007). Two additional assumptions, described in more details below, underpin the simulation of this scenario. First, the additional public infrastructure spending is financed domestically by raising direct taxes; secondly, the model includes an endogenous positive relationship between the levels of capital stock in the infrastructure sectors and aggregate productivity: therefore the faster capital accumulation in infrastructure in this scenario results in stronger GDP growth via larger (than in the baseline) productivity gains. Given the large infrastructure bottlenecks and the ongoing energy crisis already exacting significant cost to manufacturing and service activities, this seems a reasonable assumption reflecting Ghanaian reality. Clearly, it assumes also that the future additions

[13] 2004-2015 growth in current spending on water/sanitation rises from 5.4 percent per year in the baseline to 11.3 percent per year in the accelerated growth scenario, while 2004-2015 annual growth in current spending on other infrastructure rises from 5.4 percent to 8.1 percent. 2004-2015 investment growth in water/sanitation and other infrastructure quickens to 17.1 and 11.3 percent per annum, respectively. See Annex Table 9 and Table 10 for more details.

to infrastructure capital are put to productive use and are not subject to "white elephant" project choices and corruption.

Under these conditions, growth of real GDP rises to 7.4 percent per year (Table 5). By construction, public investments are higher than in the baseline, but the additional GDP growth that is generated crowds-in additional private investment response. The additional growth is driven increasingly by productivity (TFP) gains throughout the economy, which are generated by spillover effects from the improved level of service provision in infrastructure and water/sanitation.[14] Productivity gains now contribute 40% to growth in real GDP at factor cost, compared to a contribution of 38% in the baseline (see Figure 2). Due to improvements in productivity, Ghanaian products become more competitive in the world markets. This offsets the negative effects of real exchange rate appreciation in the baseline and allows export volumes to increase more relative to imports (compared to the baseline, the improvement in export growth is 0.8 percentage point per year, while import growth accelerates by 0.5 percentage points per year). Although this accelerated growth scenario is not explicitly export-driven (i.e., the initial "push" comes from improvements in public infrastructure and water/sanitation), faster export growth plays a key role in moving Ghana up to a higher growth path.[15]

There is no costless, sustained acceleration in growth, and the private sector may have to bear part of the burden. In the accelerated growth scenario, the investments in infrastructure and water/sanitation sectors are financed through direct taxes, which results in the 2015 share of direct taxes to GDP rising from 5.7 percent in the baseline to 8.0 percent in the accelerated growth scenario. This has chilling effects on private consumption: while GDP growth rate increases by half a percentage point per year (from 6.9 percent per year in the baseline to 7.4 percent per year in the accelerated growth scenario), the increase in the growth rate of private consumption is only 0.1 percentage points per year. While it is possible to pursue alternative financing mechanisms for the investment projects in the bottleneck sectors (e.g., domestic or foreign borrowing), these also have their drawbacks (such as crowding out of private investment) and the implications of each financing choice should be carefully considered.

Table 6 Ghana: Projected MDG achievements in the accelerated growth scenario

		1990	2004	2015	Target	Distance to target
Poverty headcount	(%)	52	30	10	26	402%
Primary completion rate	(%)		47	94	100	88%
Under-5 mortality	(per 1,000)	122	112	94	40	24%
Maternal mortality	(per 100,000)	740	503	427	185	24%
Access to safe water	(%)	54	56	76	85	70%
Access to sanitation	(%)	21	35	72	85	74%

Accelerated growth leads to significant achievements in water and sanitation and generates important spillovers for other HD targets, but the non-poverty MDGs are likely to remain elusive. Table 6 shows the evolution of MDG indicators under the accelerated

[14] In technical terms, the model uses an elasticity linking investment in public infrastructure and water/sanitation to the growth of the economy-wide TFP.

[15] The contribution of net exports to growth in the accelerated growth scenario is -27 percent, compared with -30 percent in the baseline scenario.

growth scenario described above. The largest improvements are observed in the water and sanitation sector, which benefits directly from increased public expenditures in this area and indirectly (through spillover effects) from the accelerated path of infrastructure investment. *In this scenario, an additional 14 percent of the Ghanaian population receive access to an improved water source in 2015 (relative to baseline), and an additional 25 percent of the population gain the use of safe sanitation facilities*.

Under the definition of water and sanitation goals adopted by United Nations Millennium Declaration, which stipulates that the percentage of population without access to safe water and sanitation should be reduced by one-half from the 1990 levels, these achievements are more than sufficient to reach the goal on sanitation (61 percent under this definition) and nearly enough to reach the water target (77 percent under this definition). However, the Government of Ghana has set its sights on a more ambitious coverage ratio of 85 percent of population, and that threshold is not attainable even in the high growth scenario. In other areas, the performance of health and education targets also improves significantly relative to the baseline. For child and maternal mortality, the relevant incidence declines by 3 and 13 cases, respectively. In primary education, an additional 6 percent of school-aged population is able to complete the 6-year education cycle, getting 88% of the way to reach universal completion. However, despite the acceleration in progress and improved prospects for reaching the MDGs, none of the non-poverty targets are likely to be met by 2015.

The results of the accelerated growth scenario suggest that additional scaling up of resources will be needed in order to reach the MDGs. If the additional MDG-related spending is financed through foreign aid, these grants would have to rise to 10.9 percent of GDP in 2015 (

Table **7**). This represents foreign aid levels of approximately US$82 per capita in 2015, over and above the current aid levels which were incorporated into the baseline scenario.[16] The main reason the financing gap is so large even with accelerated growth is that there is relatively little difference between the performance of health MDGs in the baseline and the accelerated growth scenarios. The health goals are by far the most costly to achieve—the MBB model partial equilibrium costing of achieving the health MDGs puts the total cost at nearly 12 billion USD over the 2005-2014 period—and therefore play a large role in determining the total cost envelope. Thus, even with accelerated growth, Ghana may require access to large amounts of additional resources, most likely in the form of foreign aid—US$13 billion over the 2005-2015 period—in order to ensure the attainment of the full set of MDGs considered in the MAMS model. Although foreign grant financing is not the only means of raising the fiscal revenues necessary to reach the MDGs, other financing mechanisms (raising taxes, borrowing domestically or from foreign sources) have important macroeconomic implications and are likely to give rise to the same broad magnitude of the required scaling up.

Starting from the accelerated growth scenario, where significant infrastructure spending has already been financed through domestic resources, this helps to reduce the needs for even larger inflows of foreign assistance. If Ghana had to achieve the MDGs starting from the baseline, foreign grants would have to rise to 12.9 percent of GDP in 2015. Of course, the roughly US$2.4 billion (at 2004 prices) reduction in foreign aid requirements

[16] The 2004-2006 average per capita aid in Ghana was US$60 (Ghana Joint Assistance Strategy, 2007).

due to accelerated growth cannot be considered "cost savings" because additional domestic spending had to take place to decrease the amount of additional foreign aid. To get a true measure of "the MDG dividend of growth"—the cost savings due to accelerated growth—Figure 4 contrasts the total (current and capital) spending by the government under a MDG scenario that starts from the baseline (i.e., no removal of growth bottlenecks) and a MDG scenario that incorporates accelerated growth (i.e., removal of growth bottlenecks). The figure shows that while total public spending in the accelerated growth MDG scenario is always higher (due to additional investment in infrastructure), the HD expenditure is consistently lower. HD costs depend on the interaction of two factors. On the one hand, faster productivity growth in the private sector leads to higher wages, which then drive up the costs of reaching the MDGs. On the other hand, growth-enhancing investments in infrastructure reduce the costs of attaining the MDGs through positive spillovers and demand-side effects. Overall, the second set of factors—the growth effect—outweighs the first and, starting from the accelerated growth scenario, the costs of reaching the MDGs are lower.

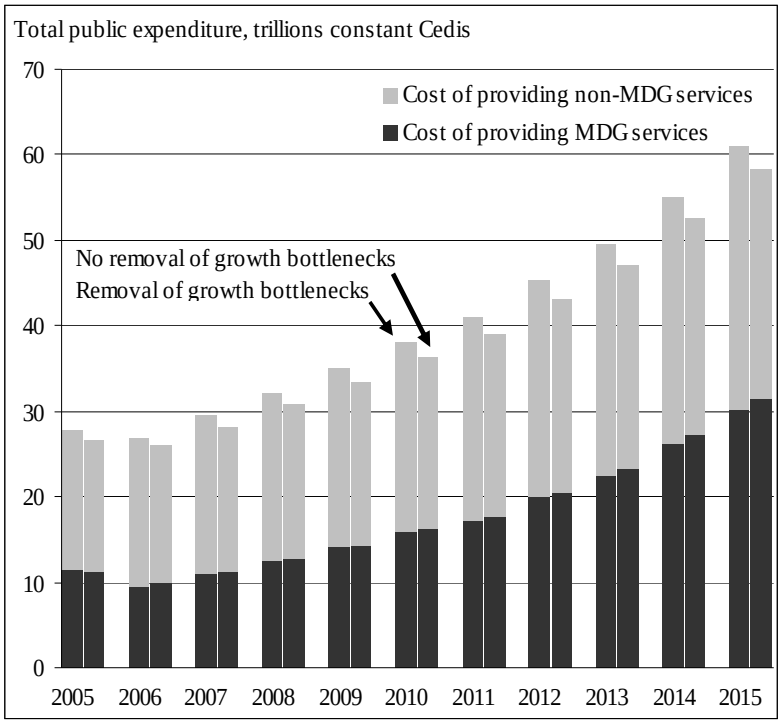
Table 7 Ghana: Structure of public finance (% of nominal GDP)

	2004	Accelerated growth	MDG achievement with foreign grants **2015**
Total current revenues	**29.92**	**30.17**	**28.69**
Direct taxes	7.19	8.00	7.82
Indirect taxes	10.32	10.53	10.43
Import taxes	3.60	3.67	3.62
Export taxes	1.17	0.95	0.65
Current transfers	7.63	7.03	6.17
Total Current Expenditures	**19.14**	**20.10**	**23.51**
Consumption: MDG-related	6.47	7.02	10.83
Consumption: other	5.70	6.66	6.79
Transfers and interest payments	6.96	6.41	5.89
Public Savings	**10.78**	**10.07**	**5.17**
Public Investment	**12.38**	**13.02**	**18.80**
Overall Balance	**-1.60**	**-2.95**	**-13.62**
Domestic borrowing	0.33	2.40	2.22
Foreign borrowing	1.27	0.56	0.47
MDG-related foreign grants	0.00	0.00	10.93

Rather than assuming that the increase in services required to achieve the MDGs is entirely brought about through an increase in the *volume* of public spending, it is also possible to contemplate increases in the *efficiency* of public spending, thereby reducing the need for additional financing. This possibility suggests itself both in view of the large size of the public spending that would otherwise be required to achieve the MDGs and in light of sectoral evidence on the apparently low efficiency performance in education, health, and water/sanitation in Ghana. For simplicity, it is assumed that the efficiency improvements are similar in all areas of public spending, although it is likely the case that

some sectors (e.g., health) may need larger improvements in efficiency than, for example, education. MAMS estimates suggest that if the level of foreign grants is constrained to 40 percent of the amount needed in the "full" foreign grant scenario, the overall level of public sector efficiency would need to rise by 49 percent relative to the 2004 levels. This means that in primary education, the same outcome could be achieved with 19 percent fewer teachers (relative to the "full" foreign grant scenario), while in health, the MDGs could be reached with 21 percent fewer physicians. Overall, the cost savings from increased efficiency amount to US$7.8 billion (starting from the accelerated growth scenario and reaching the same HD targets as in the MDGs' achievement scenario) over the 2004-2015 period. Rather than suggests a specific normative view of required efficiency gains, this serves to illustrate a basic point that while (i) there is scope for significant efficiency gains in the social sectors, (ii) additional, well targeted and spent resources are required to achieve the full set of MDGs considered in this exercise.

Figure 4: Resource requirements for full achievement of MDGs



The pursuit of MDGs has important consequences for the macroeconomy. Due to the sustained inflows of foreign aid in the foreign grants MDG scenario, real GDP growth accelerates by an additional 0.4 percentage points per year relative to the accelerated growth scenario (Table 4). The aid inflows have important "Dutch disease" implications for Ghana: by raising incomes and spending on consumption goods, they result in increased consumption of imports and loss of export competitiveness, which are manifested in real exchange rate appreciation. In particular, the growth of exports is dampened significantly relative to the accelerated growth scenario, although it still remains above the baseline. Although a permanently higher level of the real exchange rate may represent a new equilibrium for the economy, the real danger lies in a sudden cessation of aid flows—a kind of international aid "sudden stop" equivalent of private

capital flows—which could lead to large adjustment costs in Ghana as the entry and exit of firms is rarely a symmetric process. In this scenario, the investment-to-GDP ratio reaches the very high level of 41 percent, 10 percentage points higher than the level reached in the accelerated growth scenario. Although private investment rises, most of the increase is due to public investment (in MDG-related sectors) which reaches average yearly growth rate of 13 percent. Maintaining this rate of growth may not be feasible and the government of Ghana may have to elicit the private sector participation in this investment plan. Assuming that the underlying sector experts' estimates are correct and the necessary MDG-related investments are of these large magnitudes, a more balanced public and private contribution to the achievements of the MDGs may be the best solution. This solution is also more sustainable in the long term, when foreign grants are likely to be phased out.

There are several important feedback mechanisms from the efforts to attain the MDGs to labor market performance. The policy of keeping children in school and encouraging them to continue to higher education levels has two important consequences. Initially, this leads to a slowing of growth of the supply of unskilled workers while in the later periods the graduates enter the labor force at higher skill levels. This can be seen in the steadily falling growth rates of unskilled labor supply across the various simulations shown in Table 8 and the accelerating growth of the supply of skilled and tertiary-skilled workers. In turn, changes in factor supply have important consequences for the wage dynamics. In the accelerated growth and MDG achievement scenarios, wages of unskilled workers grow faster than in the baseline due to the relative scarcity of unskilled labor (compare the growth rates in the stock of unskilled labor across the three simulations). In the same scenarios, wages of skilled and tertiary-skilled workers also grow faster, but for different reasons. The large demand for secondary and particularly tertiary graduates (teachers, doctors, and engineers) outweighs the increased growth rate of supply and wage gains accelerate significantly relative to the baseline. These wage dynamics give rise to both optimism and caution. On the one hand, the acceleration of growth in unskilled wages is likely to generate additional gains in poverty reduction, since the majority of the poor earn the bulk of their income from unskilled labor. On the other hand, rising wages of skilled and tertiary-skilled public employees (due to high demand) can lure skilled workers away from the private sector and deprive it of the critical mass of skills necessary for sustained long-term growth.

Table 8 Ghana: Factor market performance

		Base year	Average 2004-2015 growth rate (%)		
		(2004)	Baseline	Accelerated growth	MDG achievement
Unskilled labor	(000)	4,238	3.1	2.4	2.4
Skilled labor	(000)	3,450	3.5	3.2	3.8
Tertiary-skilled labor	(000)	196	5.0	4.9	5.5
Private capital	(index)	140	5.6	5.8	6.4
Unskilled wage	(000 Cedis)	4,197	3.6	4.8	4.9
Skilled wage	(000 Cedis)	6,283	3.9	4.7	4.8
Tertiary wage	(000 Cedis)	21,803	3.4	4.6	6.4
Capital rent	(index)	0.2	1.6	1.8	1.7

The rising demand for skills and faster growth of skilled wages have important consequences for the distribution of income and poverty reduction. Growing wage differentials increase income inequality, which means that much of the inequality reduction recorded in the baseline scenario is reversed. In the MDG achievement scenario, the Gini coefficient reaches 0.386 in 2015, up from 0.380 in the baseline, although still down from 0.389 in the base year.[17] This is one of the reasons why the MDG achievement scenario fails to deliver more impressive poverty reduction: the poverty headcount is equal to 9.9% in 2015, very close to the 10.3% of the accelerated growth scenario.

The distribution of gains in per capita consumption, shown by the higher of the two growth incidence curves in Figure 3, makes it clear that, adjusting for the differences in mean growth, the MDG-achievement scenario is *less* pro-poor than the baseline. Although many more people escape poverty in the MDG achievement scenario than in the baseline and the gains among the poorest of the poor are comparable across the two scenarios, the above-average gains enjoyed by the poor in the former simulation begin to converge towards the average much quicker than in the latter scenario. However, this slight increase in inequality relative to the accelerated scenario must be viewed in proper context. First, as it was done for the baseline case, it is possible to simulate the effect of the MDG achievement scenario on poverty in a case where the distribution of the gains is equal for all individuals (i.e., the original distribution of 2004 is unchanged). In this case poverty reduction would be less pronounced and the headcount for 2015 would be equal to 10.2%. Second, it is important to emphasize that the results presented here do not necessarily not imply a "worsening" of income inequality. These outcomes are underpinned by rising premiums for education, which in the long term will encourage more children to attend school and potentially raise economy-wide productivity levels: there is such thing as a "good" increase in income inequality justified by more productive human capital At the same time, the results highlight the potential need for public programs to help individuals cope with rising income disparities, particularly in the short term.

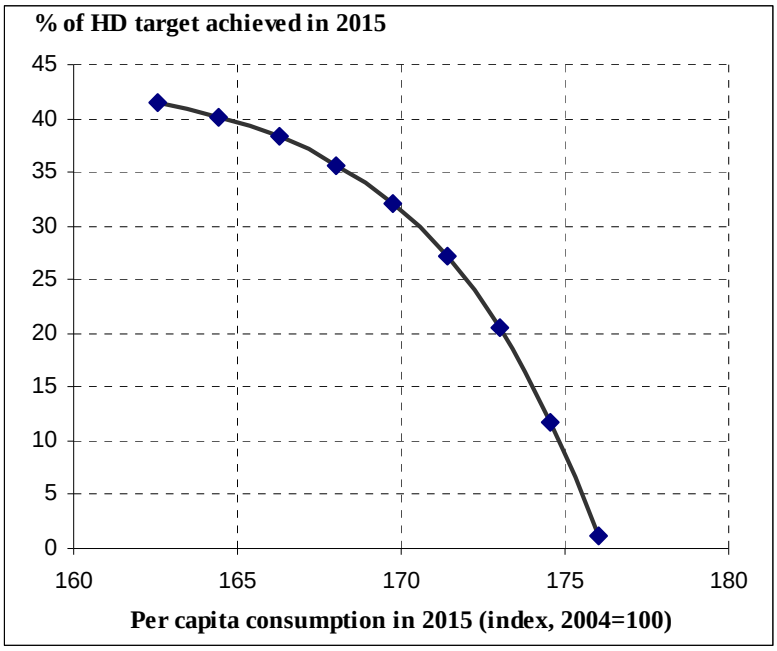
Despite the many complimentary relationships between human development and growth, important trade-offs exist between these two broad public policy objectives. The allocation of public expenditure across various activities becomes particularly relevant under fiscal space constraints. One may broadly distinguish between investing in activities that are beneficial to growth over the short to medium term as well as the long term (such as infrastructure) and HD-related activities that do not have immediate feedbacks to growth, although are beneficial to growth in the long term. As already mentioned, MAMS does not include an explicit policy tool for the government to target the poverty MDG, although expenditure shifting from HD-intensive activities to infrastructure may result in accelerated growth that is normally associated with a faster rate of poverty reduction. Starting from the baseline scenario, Figure 5 presents a series of MAMS simulations aimed at quantifying this HD-poverty trade-off for Ghana.[18] For

[17] Similarly, the Theil index in the MDG achievement scenario rises to 0.260 from 0.250 in the baseline (both numbers refer to 2015), although still down from 0.263 in 2004.

[18] This implies that MDG-related foreign grants are kept at zero (their initial level) throughout the model horizon, while foreign and domestic borrowing as well as tax rates remain at baseline levels. Public

each simulation, the horizontal axis of Figure 5 shows the 2015 level of consumption per capita in Ghana, while the vertical axis shows the average level of achievement of the non-poverty MDGs considered in this application. The trade-off curve is concave, implying that additional investment in either HD or infrastructure services results in progressively smaller improvements in the relevant indicators. An "optimal" choice is likely to combine appropriate mix of infrastructure and human development spending that will help avoid bottlenecks and sustain balanced, dynamic growth in the long run.

Figure 5: Infrastructure-human development trade-off in Ghana



4. Conclusions

This paper has relied on the MAMS model to illustrate the economy-wide effects of the pursuit of accelerated growth and MDG achievement strategies in Ghana. Given the assumptions and uncertainty surrounding the future path of some key variables (such as, for example, the availability of international aid), the results from the three scenarios considered in our analysis should be taken with a grain of salt and should not be interpreted as precise forecasts, but rather as long-term implications of alternative growth paths and policy and aid packages. Despite the inherent numeric imprecision in our estimates, several important lessons can be drawn from the analysis.

If the assumptions of the a favorable medium-term outlook hold—and this has been the case as of early 2008—Ghana is likely to faces good growth prospects and is likely to achieve the poverty MDG well ahead of schedule. Our micro-simulations show that the proportion of Ghanaians living below the poverty line could fall to 11.4 percent, an impressive achievement for a country where more than half of the population lived in poverty in 1990. In addition, given the public expenditure plans reflected in the budget,

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spending on infrastructure varies exogenously from 10 to 190 percent of the expenditures committed in the baseline, and MDG achievement is endogenous.

Ghana can expect to make further improvements in the MDGs in water and sanitation, health and education. However, their achievement would remain elusive due to large, additional resource requirements. If the government is able to address the existing infrastructure gaps in energy, water and sanitation, rural roads and ICT, growth could accelerate further, enhancing poverty reduction and the attainment of other MDGs. However, this scenario is conditional on improved policy environment and public expenditure management and the ability of firms to reap productivity spillovers from the improvements in infrastructure quality; furthermore, taxpayers are likely to bear the cost of additional investment, thus crowding out the private sector. Finally, to reach the key MDGs in health, education, and water and sanitation by 2015, Ghana may require large amounts of additional resources on the order of an annual average of US$820 million per year during the 2007-2011 period and another $1.98 billion during 2012-2015. These are significant resources, but they indicate the magnitude of the likely resource requirements to achieve the ambitious social objectives in Ghana even with strong policy environment and continued productivity gains. Given the large magnitude of the needed aid flows, Ghana may need to consider alternative or complementary sources of financing, including improvements in the efficiency of service delivery, domestic taxes, or prudent borrowing.

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6. Annex

Table 9: Public expenditure (in real terms) on MDG-related services: baseline

	2004		2015		Average growth (%)	
	Per capita (000 LCU)	% of GDP	Per capita (000 LCU)	% of GDP	Per capita	% of GDP
Total spending (ex. transfers and interest)	896	24.5	1,246	21.7	3.05	-1.11
Social spending	556.1	15.3	717.2	12.6	2.34	-1.78
General government. spending	339.5	9.2	529.1	9.1	4.12	-0.08
Total social spending by type						
Current spending	238.5	6.73	296.8	5.34	2.01	-2.08
Wages	220.3	5.97	274.0	4.72	2.01	-2.11
Non-wage	18.2	0.8	22.8	0.6	2.04	-1.83
Investment spending	317.6	8.61	420.4	7.25	2.58	-1.56
Share of current spending	42.9		41.4			
Share of investment spending	57.1		58.6			
Total social spending by activity						
Primary education	105.6	2.86	122.8	2.12	1.38	-2.71
Secondary education	121.3	3.29	131.7	2.43	0.75	-2.71
Tertiary education	71.8	1.95	77.9	1.44	0.75	-2.71
Health	107.2	2.91	136.5	2.88	2.23	-0.08
Water and sanitation	26.5	0.72	31.2	0.62	1.50	-1.38
Public infrastructure	133.5	3.62	157.2	3.11	1.50	-1.38

Note: LCU stands for local currency units

Table 10: Composition of public spending on MDG-related services: baseline

		2004	2010	2015	Annual growth (2004-2015)
Government current MDG-related expenditures					
Primary education	(bn lcu)	1,825	2,306	2,801	4.0
Secondary education	(bn lcu)	1,322	1,671	2,030	4.0
Tertiary education	(bn lcu)	930	1,175	1,428	4.0
Health	(bn lcu)	1,045	1,548	2,149	6.8
Water and sanitation	(bn lcu)	45	61	80	5.4
Public infrastructure	(bn lcu)	210	287	374	5.4
Government MDG-related investment					
Primary education	(bn lcu)	463	585	711	4.0
Secondary education	(bn lcu)	1,306	1,650	2,004	4.0
Tertiary education	(bn lcu)	625	789	959	4.0
Health	(bn lcu)	1,277	1,893	2,628	6.8
Water and sanitation	(bn lcu)	529	724	942	5.4
Public infrastructure	(bn lcu)	2,682	3,675	4,778	5.4

Note: Annual growth rate for investment in primary education is calculated for the 2004-2010 period.

Table 11: Resource requirements for full achievement of MDGs fulfilled with foreign grants

	Accelerated growth	Baseline	Accelerated growth	Baseline
	billions of USD		% of GDP	
2005	0.6	0.7	5.8	6.5
2006	0.4	0.5	3.6	4.4
2007	0.5	0.6	4.3	5.2
2008	0.7	0.8	5.3	6.2
2009	0.8	0.9	5.7	6.7
2010	1.0	1.2	6.8	7.9
2011	1.1	1.3	6.7	7.9
2012	1.5	1.7	8.1	9.5
2013	1.7	2.0	8.5	10.0
2014	2.2	2.6	10.2	12.0
2015	2.6	3.1	10.9	12.8
cumulative 2005-2015	13.0	15.4		

Note: The 'accelerated growth' column shows the resource requirements needed to reach the full set of MDGs under foreign grant financing when the initial point is the accelerated growth scenario. The 'baseline' column shows the same resource requirements when the initial point is the baseline scenario.